JC13 Rec'd PCT/PTO 0 4 APR 2001

FORM PTO-1390 (REV 10-2000)

U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 01100/LH

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 09/806738

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/07773	11 October 1999	12 October 1998

TITLE OF INVENTION: ATM CONNECTION ADMISSION CONTROL DEVICE FOR DBR CONNECTIONS

APPLICANT(S) FOR DO/EO/US: Pieter Hendrik Albert VENEMANS

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [XX] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [XX] This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. [ ] The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. [XX] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. [X] is attached hereto (required only if not communicated by the International Bureau).
   - b. [ ] has been communicated by the International Bureau.
   - c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   - b. [ ] have been communicated by the International Bureau.
   - c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   - d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [XX] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 16 below concern document(s) or information included:

11. [XX] An Information Disclosure Statement under 37 CFR 1.97 and 1.98. ; PTO-1449; 9 references.
12. [XX] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [XX] Other items or information:

Int. Search Report;
5 sheets formal drawings (Figs. 1-5); Forms PCT/RO/105; PCT/IB/318; PCT/ISA/220; PCT/IPEA/416; PCT/IPEA/409; PCT/IPEA/402; PCT/IPEA/401;
Priority document w/translation;
Change of Corres/Address w/barcode.

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Date of Deposit: April 4, 2001

I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231

Barbara Villani

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09806738 . 040401

JC02 Rec'd PCT/PTO 04 APR 2001

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/806738	INTERNATIONAL APPLICATION NO. PCT/EP99/07773	ATTORNEY'S DOCKET NUMBER 01100/LH

	CALCULATIONS	PTO USE ONLY
17. [X] The following fees are submitted: **BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :** Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO .... **$1000.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO....... **$860.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... **$710.00** International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)........... **$690.00** International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)............... **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	1 - 20 =	0	X $18.00	$	
Independent claims	1 - 3 =	0	X $80.00	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	$	

TOTAL OF ABOVE CALCULATIONS =	$ 860.00	
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.	$	
SUBTOTAL =	$ 860.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +	$	
TOTAL NATIONAL FEE =	$ 860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	$ 40.00	
TOTAL FEES ENCLOSED =	$ 900.00	
	Amount to be refunded:	$
	charged:	$

a. [X] A check in the amount of $ 900.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. ________ in the amount of $________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-1378. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

FRISHAUF, HOLTZ, GOODMAN, LANGER & CHICK
767 Third Avenue - 25th floor
New York, N.Y. 10017-2023

SIGNATURE.

Leonard Holtz
NAME

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REGISTRATION NUMBER

01933
PATENT TRADEMARK OFFICE

Dated: April 4, 2001

LH:bv

09/806738

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Attorney Docket No. 01100/LH

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Barbara Villani

Barbara Villani

In the event that this Paper is late filed, and the necessary petition for extension of time is not filed concurrently herewith, please consider this as a Petition for the requisite extension of time, and to the extent not tendered by check attached hereto, authorization to charge the extension fee, or any other fee required in connection with this Paper, to Account No. 06-1378.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : P.H.A. VENEMANS

Serial No. : Based on PCT/EP99/07773

Filed : Herewith

For : ATM CONNECTION ADMISSION CONTROL DEVICE FOR DBR CONNECTIONS

Art Unit :
Examiner :

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents and Trademarks

S I R :

IN THE SPECIFICATION:

Page 1: Please insert the following as the first sentence:

--This application is a U.S. National Phase Application under 35 USC 371 of International Application PCT/EP99/07773 (published in English) filed October 11, 1999.--

Respectfully submitted,

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#3 C. Burt 07 June 01

MAY 29 2001

Attorney Docket No. PHN 17,161

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): P.H.A. VENEMANS

Serial No. : 09/806,738

Filed : April 4, 2001

For : ATM CONNECTION ADMISSION CONTROL DEVICE FOR DBR CONNECTIONS

Art Unit :
Examiner :

LETTER RE: DRAWINGS - RESPONSE TO NOTIFICATION OF MISSING REQUIREMENTS

Assistant Commissioner of Patents
Washington, D.C. 20231

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class mail with sufficient postage in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on the date noted below.

Attorney: Leonard Holtz

Dated: May 23, 2001

In the event that this Paper is late filed, and the necessary petition for extension of time is not filed concurrently herewith, please consider this as a Petition for the requisite extension of time, and to the extent not tendered by check attached hereto, authorization to charge the extension fee, or any other fee required in connection with this Paper, to Account No. 06-1378.

S I R :

Responsive to the NOTIFICATION (Form PCT/DO/EO/905) mailed April 26, 2001 (copy attached), submitted herewith are the following:

1. Complete set of formal drawings, including Fig. 1 with all English language legends thereon; and
2. A copy of prior Fig.1 with the changes shown in red thereon. The changes shown in red are to provide English translations of foreign language legends.

It is respectfully submitted that the drawings now include all English language legends and are now in compliance with Patent

level of B cells being exceeded is designated by $Q_D^N(B)$. The arithmetic unit determines the lowest value of B, such that $Q_D^N(B) < \varepsilon$, where N is equal to the number of sources, D is equal to N / ρ and $Q_D^N(B)$ is the formula as given above or a sufficiently accurate approximation thereof. The value of B found in this way forms the value of B_N.

- An arithmetic unit which multiplies the calculated value B_N by the constant K. For this result, to be referred to here as B_{NK}, it holds that it is possible to multiplex N imaginary, identical traffic streams, each with a burst rate of K, using a buffer of size B_{NK}, such that the probability of cell loss as a result of buffer overflow will not exceed the given value of ε. In this regard it will be assumed that the average degree of occupation at the output of the buffer is equal to ρ.
- An arithmetic unit which determines the sum of the calculated values for B_S and B_{NK}. Said value is designated here by B_R.
- A device which compares the calculated value of B_R with the given capacity B of the output buffer. If the value of B_R is less than or equal to B, then the result of the sub-device is positive; if the value of B_R is greater than B, then the result of the sub-device is negative.

The operation of the device will be further explained hereinafter with reference to an implementation example.

INSERT A ON ATTACHED SHEET

DESCRIPTION OF THE FIGURE

Fig. 1 shows a CAC device in general. The traffic parameters (PCR and CDVT) of an arbitrary number of already existing ATM connections $v_1 \ldots v_{N-1}$ are supplied to the CAC device, as well as the traffic parameters of a newly requested ATM connection v_N. A maximally allowable cell loss probability parameter ε is furthermore supplied, as well as the applicable buffer capacity B and link capacity C. A maximally allowable degree of

INSERT A

(TO BE INSERTED IN REPLACEMENT FOR PAGE 8, LINE 26 OF SPECIFICATION)

Brief Description of the Drawings

Fig. 1 is a block diagram of a CAC device in general;

Fig. 2 diagrammatically shows the CAC device of Fig. 1;

Fig. 3 shows the sub-device 1 of Fig. 2 in greater detail;

Fig. 4 diagrammatically shows the sub-device of Fig. 2; and

Fig. 5 shows the processor 7 of Fig. 4 in greater detail.

Detailed Description

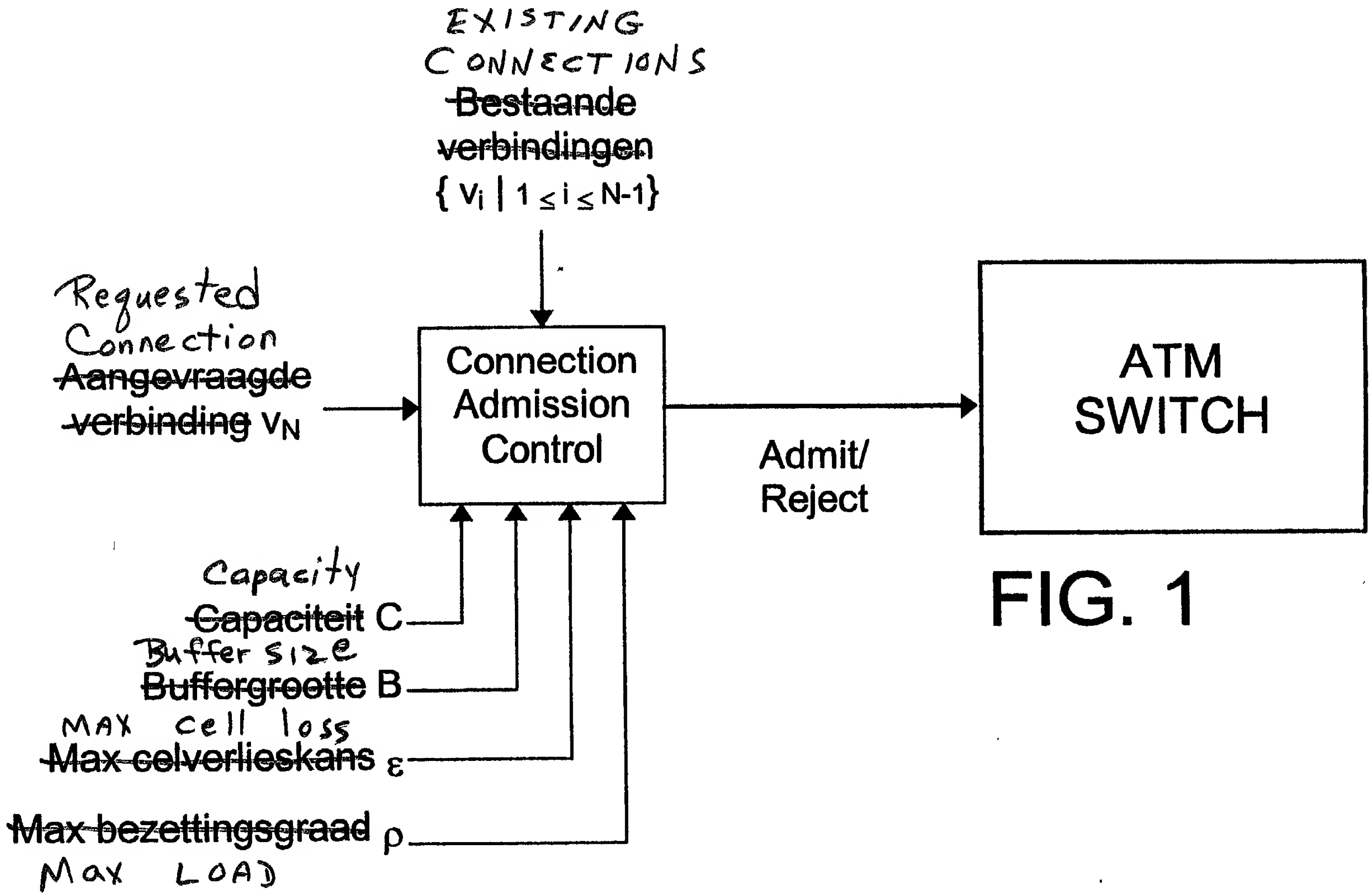

FIG. 1

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5|PRTS

Title: ATM Connection Admission Control device for DBR connections

BACKGROUND OF THE INVENTION

The invention is related to a device for Connection Admission Control (CAC) for an ATM switch, intended for admitting to said ATM switch an additional traffic stream, via an additional ATM connection of the DBR type, such that the "Quality of Service" of all DBR connections in said switch continues to meet certain conditions, a single buffer with capacity B being available for the composite traffic stream of all DBR connections at an output port with capacity C, while, as boundary condition, the total average load of the output port does not amount to more than $\rho \times C$, where ρ is a constant with a value between 0 and 1.

General

Asynchronous Transfer Mode (ATM) is a network technique allowing connections to be made in a uniform manner with varying characteristics. The transport of data takes place by means of uniform cells with a length of 53 octets. With the aid of ATM, connections can be established with varying network guarantees with respect to cell loss, cell delay, cell delay variation and throughput by selecting a "Quality of Service" (QoS) class [I.356] and an "ATM Transfer Capability" (ATC) [I.371].

Guaranteeing the values of the QoS parameters in advance is a characteristic which is focussed upon in ATM networks. In order to satisfy certain (possibly very stringent) requirements with respect to the Quality of Service in advance, including the cell loss probability, a decision must be made for each requested connection whether the latter can or cannot be admitted to an ATM switch. Connections are only admitted if the Quality of Service of the connections which make use of the ATM

switch do not exceed the limits set in advance. The entirety of methods which determine admittance or non-admittance of a requested ATM connection is called a Connection Admission Control (CAC) algorithm, a device for executing a CAC algorithm being called a CAC device.

The said "ATM Transfer Capability" (ATC) describes the parameters by which an ATM connection is characterised. The ATC referred to here comprises the "Deterministic Bit Rate" (DBR) which is established in [I.371]. In this case, an ATM connection is characterised by two parameters: the Peak Cell Rate (PCR) and the Cell Delay Variation Tolerance (CDVT). The PCR represents the maximum speed at which a connection may drive cells; the CDVT is a measure for the tolerance in the PCR. The entity CDVT denotes the degree in which the actual speed may exceed the PCR during (as a rule very short) periods of time. In order to guarantee the Quality of Service of all connections, a Usage Parameter Control (UPC) device monitors whether each of the connections indeed satisfies its characteristic during the operating period of a connection. If this is not the case, then the UPC device can resort to removing cells of the related connection from the traffic stream.

The invention relates, as indicated above, to a device which can be used for the CAC of an ATM switch, and indeed in particular for connections which satisfy the specifications of the "Deterministic Bit Rate" Transfer Capability.

THE PRIOR ART

A simple but inaccurate method for executing CAC for connections which are characterised by values for PCR and CDVT, is leaving the last parameter completely out of consideration. The method then restricts itself to determining whether sufficient capacity is available for the sum of the peak cell rates of the connections at the related output port. In this case, two matters are disregarded:

- The fact that the traffic streams of the various connections consist of discrete cells, instead of continuous streams. As a result, several cells can be routed to one specific output port at (approximately) the same time when various traffic streams are mixed. In order to prevent cell loss in such situations, it is customary to use an output buffer. The said simple method for CAC, however, does not take into account the consequences of such a buffer, such as cell loss as a result of a finite buffer capacity and delay.
- The fact that the traffic streams of the various connections can show fluctuations, in which case the momentary cell rate can temporarily exceed the nominal peak cell rate. Said fluctuations are possible if the Cell Delay Variation Tolerance (CDVT) of the connections is greater than zero. Through said fluctuations it is possible that, when an output buffer is used, the required amount of buffer capacity is, in reality, greater than that for "ideal" DBR connections (with CDVT being equal to 0). This can lead to unforeseen cell loss and/or extra delay.

The literature describes a number of methods in which the above-mentioned two problems are recognised and both the discrete character of ATM traffic streams as well as the fact that the momentary cell rate of a connection can temporarily exceed its PCR are taken into account. In [E.736] it is described that this problem can be solved by either "shaping" all traffic streams (that is to say, delaying cells in such a way that the cells of the resulting traffic streams have an intermediate arrival time of exactly 1/PCR). The resulting traffic stream can then be characterised by a CDVT which is equal to 0.

In the aforementioned reference, the "maximum burst rate" is introduced of a connection which is characterised by values for PCR and CDVT. Said maximum burst rate is the required buffer capacity to lead the related traffic stream, in an ideal

situation and without cell loss, over an imaginary buffer (without mixing of other traffic streams), assuming that the said imaginary buffer has a constant exit speed equal to PCR.

In [Gravey97] a solution with "shaping" is also proposed, albeit that connections are shaped such that their maximum burst rate is limited and small (smaller than or equal to 2).

A disadvantage of said methods is that "shaping" is not possible with all ATM switches and that introducing extra shapers in the network can be undesirable. For these reasons, [E.736] also describes a method for the case that connections have a known maximum burst rate, b_{MAX}. Said connections are then approximated by a b_{MAX} batch Poisson process. This method has the disadvantage of (1) the Poisson process being an over-estimation of the traffic, which leads to less connections being able to be admitted than is actually possible on the basis of the required QoS guarantees, and (2) the assumption of an unequivocally determined b_{MAX} for all connections, which can be unnecessarily inefficient in practice. In practice, namely, said value for b_{MAX} could be quite high. In [Gravey97] it is shown that the maximally allowable load of the ATM network decreases for increasing values of b_{MAX}.

[COST242] describes the method essentially as in [E.736], but refines it. The maximum batches which are used for approximation by Poisson batches do not always need to be the same as in [E.736], but are dependent upon the speed of the multiplexer. For a universally valid model, the batches must indeed be just as large as those of a Poisson process by which the traffic stream is approximated.

[Mignau96] describes methods which are not based on the Poisson method but on the NxD/D/1- method, which is described below. For sources in which the maximum burst rate can assume exactly two values, a complex model is described in [Cidon95]. Said model is numerically unstable, however, and requires long calculation times.

The NxD/D/1-model.

One of the models on which the present invention is based is the NxD/D/1 - model. This model provides the probability distribution of the length of the queue in a system consisting of a buffer which is controlled by one server. Said system is supplied by N ideal (i.e. CDVT equal to 0) and equal traffic streams, each having an inter-cell arrival time of magnitude D and with initial starting times uniformly distributed over an interval of magnitude D. The unit of time is the time required to control one cell. In [Cost242] it is put forward that the probability of the buffer use exceeding a certain value B is equal to:

$$\sum_{n=B+1}^{N} \binom{N}{n} \left(\frac{n-B}{D}\right)^{n} \left(1-\frac{n-B}{D}\right)^{N-n} \frac{D-N+B}{D-n+B}.$$

This formula will be designated here by $Q_D^N(B)$. In [COST242] it is also put forward that this formula also provides a good upper limit for the probability of excess if the streams have different inter-cell arrival times.

SUMMARY OF THE INVENTION

The invention seeks to provide in a device of the kind indicated in the preamble, which is pre-eminently suitable as CAC for ATM connections of the DBR type, in which both the discrete character of the traffic streams as well as the fact that the cell rate of each of the individual connections can show fluctuations above its nominal peak cell rate are taken into account. It distinguishes itself favourably from CAC devices based on the methods in the literature with respect to the following aspects:

- More efficient: the device according to the invention has the property that the maximum number of connections able to be

mixed is not limited much more than strictly necessary to prevent buffer overflow and thereby cell loss.

- Better suited to practical situations: in the current ATM networks, it is customary to select the CDVT such that this is a constant when it is expressed in the unit of time, which has as a result that the previously defined maximum burst rate b_{MAX} is dependent upon the peak cell rate of the connection; for this reason no unequivocal maximum burst rate can be established, which is a point of departure for the methods in the literature.
- Better practical applicability: the method used by the device according to the invention is practically applicable, numerically stable and has a faster calculation time.

Although the methods in the literature are also practically applicable, the CAC device according to the invention combines a high efficiency with practical applicability. The CAC device according to the invention also provides the possibility of optimising the maximum number of allowable connections by selecting a certain value for the freely selectable constant K, albeit that this must be a whole number greater than or equal to 0. In many cases, the optimal value for K will depend on the most frequently occurring values of the CDVT of the ATM connections.

The CAC device according to the invention comprises two sub-devices, each issuing a positive or negative result (signal).

The result of the whole device will be positive only if both sub-devices issue a positive result (signal), and only then will a new connection to the ATM switch be grantable. The first sub-device determines whether sufficient bandwidth is available for the set of connections V, of which each connection v_i is characterised by values for PCR_i and $CDVT_i$, which, after possible admission of the new connection, will make use of a certain output port; the second sub-device determines whether

the available buffer capacity for the related port is sufficient.

The first sub-device comprises:

- An arithmetic unit which determines the sum (ΣPCR) of the values of PCR_i of each of the connections v_i of the set V. Said sum is subsequently compared with the product of ρ and C. If the said sum is less than or equal to said product, then the result of the sub-device is positive; otherwise the result is negative.

The second sub-device comprises:

- An arithmetic unit which calculates a certain buffer size $b_{s,i}$ for each of the connections v_i of the set V. Said buffer size is equal to either $b_{max,i}$ minus the constant value K if $b_{max,i}$ is greater than or equal to K, or equal to 0 if $b_{max,i}$ is less than K. For buffer size $b_{max,i}$ it holds that it is possible, in an ideal situation, to conduct the related traffic stream without cell loss over an imaginary buffer with buffer size $b_{max,i}$ and exit speed PCR_i (without mixing with other traffic streams). $b_{max,i}$ is calculated by the device by determination of the product of PCR_i and $CDVT_i$.
- An arithmetic unit which determines the sum of the calculated values $b_{s,i}$ for all connections of the set V. Said sum will be designated here by B_S.
- An arithmetic unit which determines a buffer size B_N, for which it holds that it is possible to multiplex N imaginary, identical traffic streams with constant cell rate, using a buffer of size B_N, and indeed such that the probability of cell loss as a result of buffer overflow will not exceed the given value of ε. N is here the number of connections in set V. It is also assumed that the average degree of occupation at the output of the buffer is equal to ρ. The buffer capacity B_N is determined by application of the previously introduced NxD/D/1 model, where the probability of a buffer

level of B cells being exceeded is designated by $Q_D^N(B)$. The arithmetic unit determines the lowest value of B, such that $Q_D^N(B) < \varepsilon$, where N is equal to the number of sources, D is equal to N / ρ and $Q_D^N(B)$ is the formula as given above or a sufficiently accurate approximation thereof. The value of B found in this way forms the value of B_N.

- An arithmetic unit which multiplies the calculated value B_N by the constant K. For this result, to be referred to here as B_{NK}, it holds that it is possible to multiplex N imaginary, identical traffic streams, each with a burst rate of K, using a buffer of size B_{NK}, such that the probability of cell loss as a result of buffer overflow will not exceed the given value of ε. In this regard it will be assumed that the average degree of occupation at the output of the buffer is equal to ρ.
- An arithmetic unit which determines the sum of the calculated values for B_S and B_{NK}. Said value is designated here by B_R.
- A device which compares the calculated value of B_R with the given capacity B of the output buffer. If the value of B_R is less than or equal to B, then the result of the sub-device is positive; if the value of B_R is greater than B, then the result of the sub-device is negative.

The operation of the device will be further explained hereinafter with reference to an implementation example.

DESCRIPTION OF THE FIGURE

Fig. 1 shows a CAC device in general. The traffic parameters (PCR and CDVT) of an arbitrary number of already existing ATM connections $v_1 \ldots v_{N-1}$ are supplied to the CAC device, as well as the traffic parameters of a newly requested ATM connection v_N. A maximally allowable cell loss probability parameter ε is furthermore supplied, as well as the applicable buffer capacity B and link capacity C. A maximally allowable degree of

occupation ρ is also supplied. The result of the device is an "admit/reject" signal, on the basis of which the requested ATM connection v_N is or is not admitted to the ATM switch.

Fig. 2 shows a diagrammatic overview of a CAC device according to the invention. The CAC device is composed of a sub-device 1 and a sub-device 2. Each sub-device can emit a positive ("admit") or a negative ("reject") signal. Both signals are supplied to a logical AND port 3, of which the output signal is only positive if both input signals are positive.

Fig. 3 shows sub-device 1 in more detail. The PCR values of the N ATM connections are summed (ΣPCR) in a device 4. In a device 5, the total capacity C of the output port is multiplied by a previously established coefficient ρ ($0<\rho<1$), corresponding to the desired maximum load. The result of the arithmetic unit 6 is positive if the value of ΣPCR calculated in device 4 is less than or equal to the product of ρ x C calculated by device 5; if that is not the case, the result is negative.

Fig. 4 diagrammatically shows the sub-device 2. The traffic parameters of ATM connection i are formed by the entities Peak Cell Rate(PCR_i) and Cell Delay Variation ($CDVT_i$). For each connection the sub-device 2 comprises a processor 7, which is shown in more detail in Fig. 5. In a device 13 (see Fig. 5), each of the processors 7 calculates by multiplication the maximum burst rate $b_{max,i}$ of the two said traffic parameters. The difference between $b_{max,i}$ and K ($b_{max,i}$ - K) is calculated by a device 14. If this difference is 0 or positive, which is verified by a device 15, then $b_{S,i}$ is equal to the calculated difference of $b_{max,i}$ - K; if the difference is less than 0, $b_{S,i}$ is equal to 0. Sub-device 2 (see Fig. 4 again) consists of a number of processors 7, one for each ATM connection. The $b_{S,i}$ results of each processor 7 are summed in a device 8 and result in a total value of B_S. The total number of ATM connections N is entered in arithmetic module 9. Said module determines the lowest value of B, such that $Q_D^N(B) < \varepsilon$. This results in a value

B_N. Said value B_N is multiplied by the constant value K in a device 10 and forms the value B_{NK}. Finally, a device 11 sums the values of B_S and B_{NK} and a device 12 compares the summed value with the given available buffer size B. If B_S+B_{NK} is less than or equal to B, then a positive "admit" signal, or otherwise a negative "reject" signal, is emitted.

REFERENCES

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[E.736] ITU Telecommunication Standardization Sector, Draft Recommendation E.736, "Methods for Cell Level Traffic Control in B-ISDN", 10 January 1997.

[Mign96] J. Mignault, A. Gravey, C. Rosenberg, "A survey of straightforward statistical multiplexing models for ATM networks", Telecommunication Systems 5 (1996) 177-208.

[Grav97] A. Gravey, J. Boyer, K. Sevilla, J. Mignault, Resource Allocation for Worst Case Traffic in ATM networks, Performance Evaluation 30 (1997), 19-43.

[COST242] J. Roberts, U. Mocci, J. Virtamo (eds.), Broadband Network TeleTraffic -performance evaluation and design of broadband multiservice networks- Final Report of Action, COST 242, Lecture Notes in Computer Science Vol 1155, Springer-Verlag, Berlin; Heidelberg, 1996, ISBN 3-540-61815-5

[Cidon95] I. Cidon, R. Guérin, I. Kessler and A. Khamisy, Analysis of a statistical multiplexer with generalized periodic sources, Queuing Systems 20 (1995) 139-169.

[I.356] ITU-T I.356: B-ISDN ATM layer cell transfer performance; ITU-T recommendation I.356 (10/96); Geneva, October 1996.

CLAIMS

1. A device for Connection Admission Control for an ATM switch, intended for admitting to the switch a requested ATM connection of the DBR type, such that the "Quality of Service" of all ATM connections of the DBR type in said switch continues to satisfy certain conditions, in which a single buffer with capacity B is available for the composite traffic stream of DBR connections at an output port with capacity C, while as a boundary condition it holds that the total average load of the output port does not amount to more than ρ x C, where ρ is a constant with a value between 0 and 1, **characterised in that** the device comprises two sub-devices which each emit a positive or negative admission signal, admission to the switch only being granted to the new ATM connection if both sub-devices issue a positive admission signal,

said first sub-device (1) comprising:

- a first arithmetic unit (4) which calculates the sum (Σ PCR) of the nominal traffic parameters Peak Cell Rate (PCR_i) of each of the ATM connections of the DBR type at the related output port, including the newly requested connection;
- a second arithmetic unit (6) which compares the calculated sum (ΣPCR) with the value of ρ x C, the result of the first sub-device being negative if ΣPCR is greater than ρ x C, and the result of the sub-device being positive if ΣPCR is less than or equal to ρ x C;

and said second sub-device (2) comprising:

- for each of the ATM connections of the DBR type at the related output port, including the newly requested connection, a third arithmetic unit (7), which calculates a buffer capacity $b_{s,i}$, the value of $b_{s,i}$ being

equal to zero if the product of the nominal Peak Cell Rate (PCR_i) and Cell Delay Variation Tolerance($CDVT_i$) of the related connection is less than or equal to the constant K, and the value of $b_{S,i}$ being equal to said product minus the value of K if said product is greater than K;

- a fourth arithmetic unit (8) which calculates the sum (B_s) of the calculated values $b_{S,i}$ for all ATM connections at the related output port;
- a fifth arithmetic unit (9) which calculates a buffer capacity B_N, such that upon multiplexing of N independent, identical and ideal (CDVT = 0) traffic streams, using a single buffer with a buffer capacity of B_N, and assuming a maximum link load having a value of ρ , the average probability of cell loss as a result of buffer overflow will not exceed the given value of ε;
- a sixth arithmetic unit (10) which calculates the product (B_{NK}) of the value of B_N and the constant value K;
- a seventh arithmetic unit (11) which determines the sum (B_R) of the calculated values for B_S and B_{NK};
- a comparison device (12) which compares the calculated sum B_R with the given capacity B of the output buffer, a positive admission signal being emitted if the value of B_R is less than or equal to B, and a negative admission signal being emitted if the value of B_R is greater than B.

ABSTRACT

A device for Connection Admission Control for an ATM switch, intended for admitting to the switch a requested ATM connection of the DBR type, such that the "Quality of Service" of all ATM connections of the DBR type in said switch continues to satisfy certain conditions. For the composite traffic stream of DBR connections at an output port with capacity C, a single buffer with capacity B is available, while as boundary condition it holds that the total average load of the output port does not amount to more than ρ x C, where ρ is a constant with a value between 0 and 1. The CAC device comprises two sub-devices, which each execute a - rather complex - partial calculation, resulting in a positive or negative admission signal. The new ATM connection is only granted admission to the switch if both sub-devices emit a positive admission signal.

(FIG. 1)

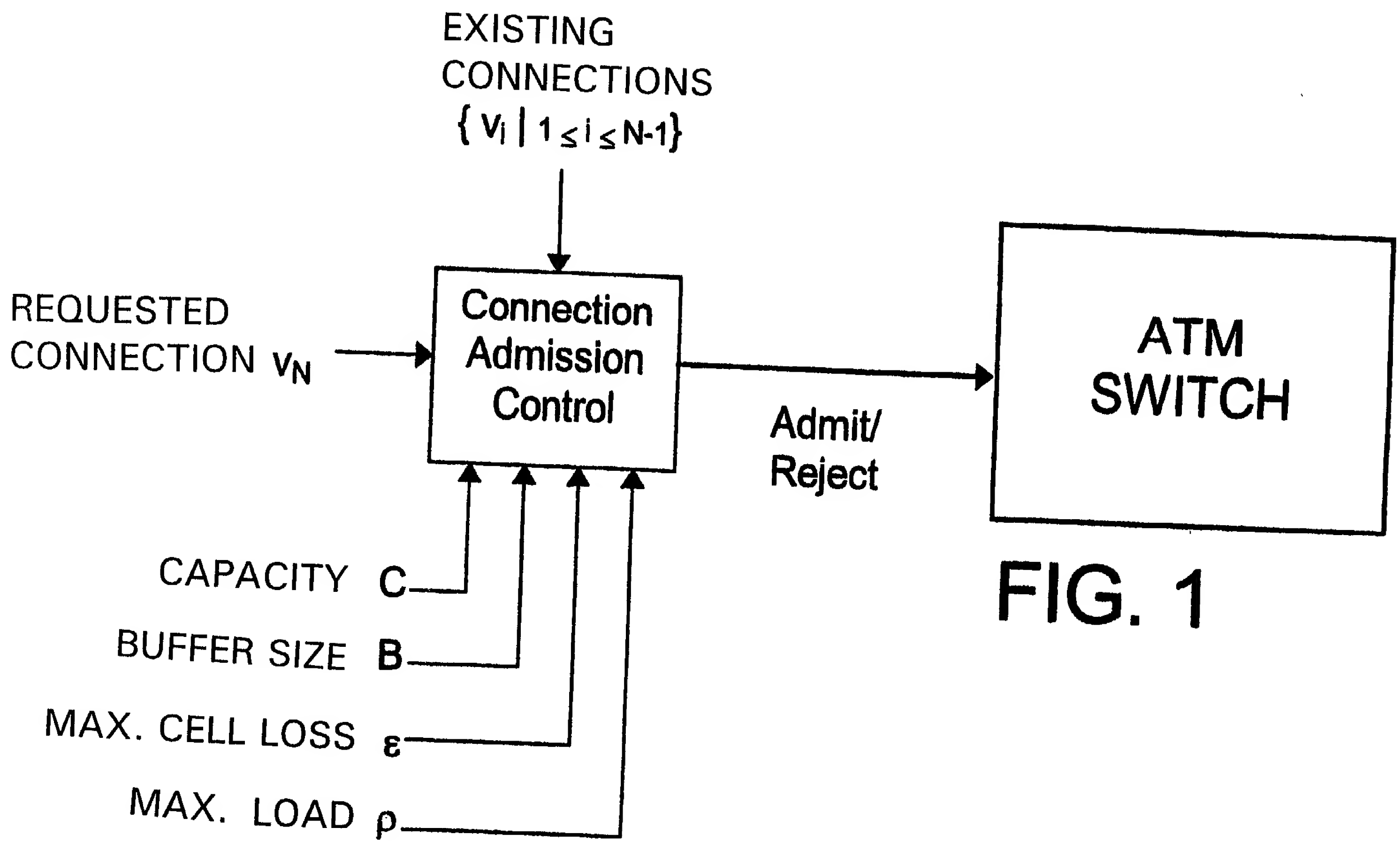

EXISTING
CONNECTIONS
$\{ v_i \mid 1 \leq i \leq N\text{-}1 \}$
REQUESTED
CONNECTION v_N
Connection
Admission
Control
Admit/
Reject
ATM
SWITCH
CAPACITY C
BUFFER SIZE B
MAX. CELL LOSS ε
MAX. LOAD ρ

FIG. 1

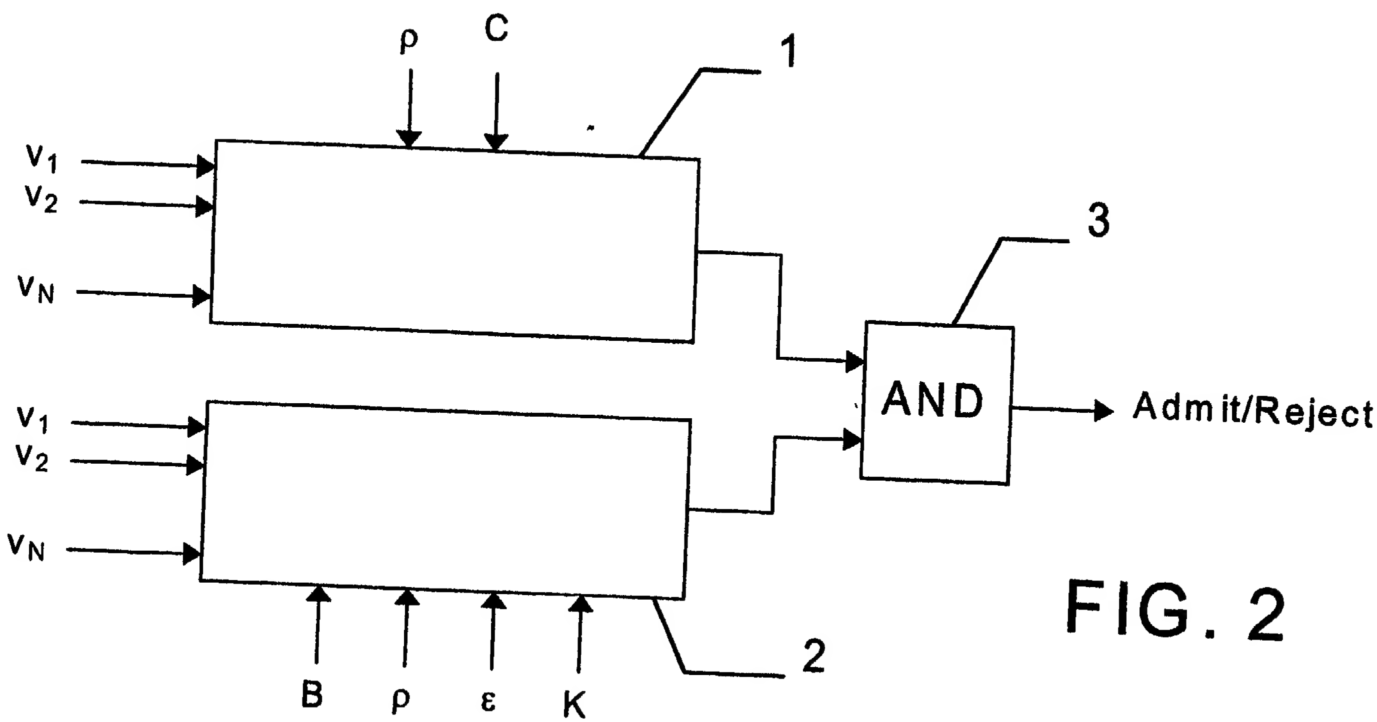


FIG. 2

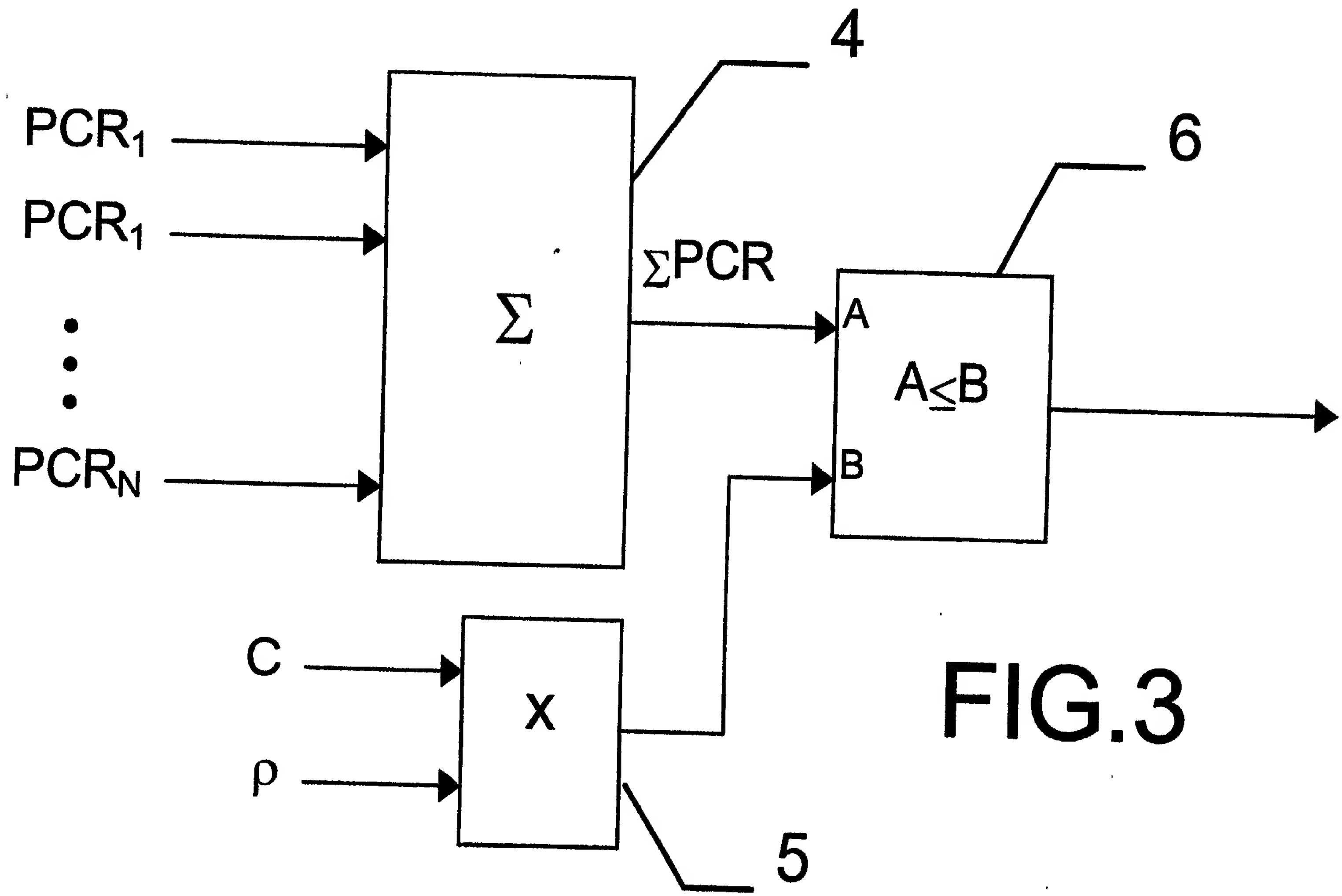
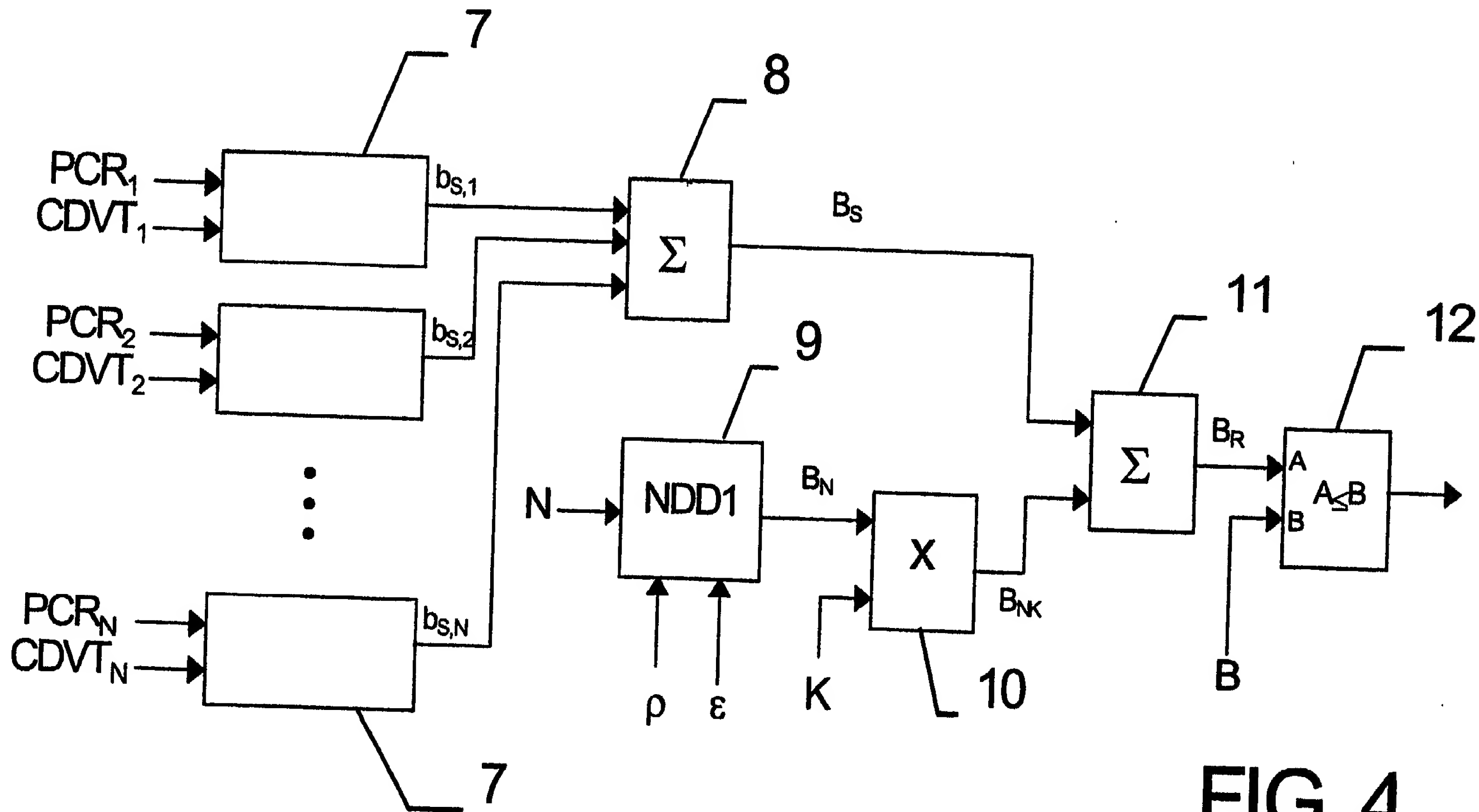


FIG.3



7
8
PCR1
CDVT1
bS,1
BS
Σ
PCR2
CDVT2
bS,2
11
12
9
N
NDD1
BN
X
Σ
BR
A
A≤B
B
PCRN
CDVTN
bS,N
ρ
ε
K
BNK
10
B
7

FIG. 4

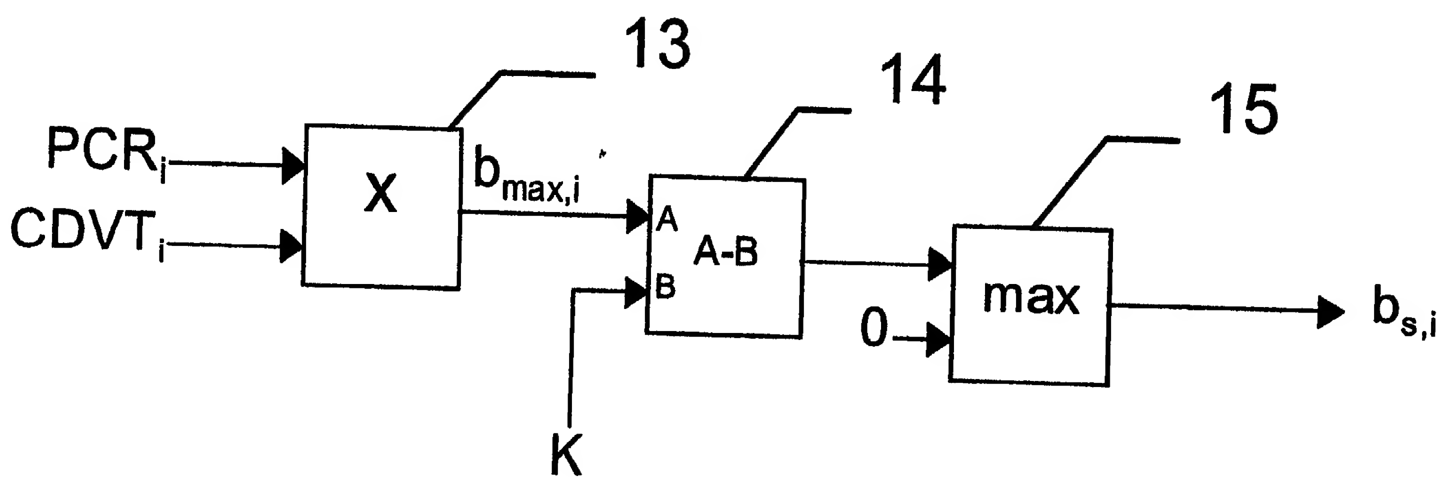


FIG. 5

U.S. Attorney Docket ______________

APPLICATION FOR UNITED STATES LETTERS PATENT
PCT Declaration and Power of Attorney (35 U.S.C. 371(c)(4))
PCT Application - United States Designated Office

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:
"ATM connection admission control device for DBR connections".

described and claimed in International Application number PCT/EP99/07773 filed on 11 October 1999

I have reviewed and understand the contents of said specification, including claims.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I claim priority benefits under 35 USC §119 of: (i) any foreign application(s) for patent or inventor's certificate listed below; or (ii) any United States provisional application(s) listed below; and have also identified below any foreign application(s) for patent or inventor's certificate, or PCT international application having a filing date before that of the application(s) on which priority is claimed.

COUNTRY	APPLICATION NUMBER	DATE (day, month, year)	PRIORITY CLAIMED
The Netherlands	1010295	12 October 1998	yes x no ____
			yes ____ no ____

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I appoint the following attorneys to prosecute this application and to transact all business in the U.S. Patent & Trademark Office connected therewith: Stephen H. Frishauf, Reg. No. 16,233; Leonard Holtz, Reg. No. 22,974; Herbert Goodman, Reg. No. 17,081; Thomas Langer, Reg. No. 27,264; Marshall J. Chick, Reg. No. 26,853; Richard S. Barth, Reg. No. 28,180; Douglas Holtz, Reg. No. 33,902; and Robert P. Michal, Reg. No. 35,614.

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